International® Baccalaureate

Backward Mapping the IB Curriculum

GRADES 9–12

Math

(Mathematics SL & Math Studies SL)

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DRAFT MATERIALS

These maps were created with funding from the United States Department of Education in order to increase participation and success in the Diploma Programme by strengthening the MYP-Diploma Programme articulation in the traditional 9–12 high school model. Schools and districts that offer all five years of the MYP are encouraged to continue the process of mapping skills back to level one of the MYP.

International Baccalaureate

Backward Mapping

THE IB CURRICULUM:

Diploma Programme Mathematics

CONTENTS

Introduction to IB Mathematics

This collection of curriculum maps aims to support schools in connecting the MYP and Diploma math curriculum in order to prepare students for the final assessments in Math Studies SL or Mathematics SL. The following resources are included:

DP Skills Analysis

This document identifies the skills and concepts necessary for success on the final DP assessment for the subject area.

- **9-12 Skills Map**
  This document maps over grades 9-12 the skills and concepts required for success in the DP.
- **MYP Assessment Map**
  This documents connects the MYP assessment criteria to the final DP.
- **MYP Course Outline and Unit Plans (Grades 9 & 10)**
  This document offers sample course outlines and units for MYP courses in grades 9 and 10

The vertical 9-12 Skills Map, lists the topics in 9th grade Geometry and 10th grade Algebra II that are also included in, or necessary for, success in the 11th and 12th grade IB math courses; Mathematical Studies Standard Level (Math Studies SL) and Mathematics Standard Level (Math SL).

The vertical maps for grades 9 through 12 were written to reflect the topics included in the Math studies SL or Math SL syllabus. The order and year these topics are taught is to be determined by the teachers. The map is only an example and distribution of topics each year can be reorganized however the teachers deem suitable. Both courses, Math Studies SL and Math SL should be taught over a two-year period. This will ensure time to thoroughly address each topic, properly address the Internal Assessment, review and prepare for the examination.

Since the 9th and 10th grade math teachers may not know which IB Diploma math course their current students will take in grades 11 and 12, a map was created for each. It is suggested that each map be inspected and studied thoroughly by all 9th and 10th grade math teachers. These maps do not indicate additional topics to be taught, but rather give grade 9 and 10 teachers a sense of those topics in their current curricula which are essential building blocks for their students' future Diploma math curriculum. It is suggested that the teacher stress these topics and continually refer to them throughout the course using a spiraling technique. The 10th grade teacher should continue to review and assess the topics taught in the 9th grade.

It is also suggested that the 9th and 10th grade teachers become familiar with the subject guide for Math Studies SL and the subject guide for Math SL. These guides are available at the Online Curriculum Centre (occ.ibo.org). The teacher will need a school number, user name and password in order to open the website. Teachers should pay particular attention to the section labeled "Presumed Knowledge" and section labeled "Syllabus Content". The Diploma Program Coordinator Notes (DPCN) are also available on the Online Curriculum Centre. These are published quarterly and include changes and updates of which all teachers should be aware. Please check for the latest DPCN to keep current with new information regarding the Diploma Program, specifically mathematics (in group 5).

It is extremely important that the math teachers refer to previously learned topics throughout the course. The teachers should also give the students ample opportunities to take examinations under time constraints.

All math teachers (9th – 12th grade) should use the terminology and notation from the IB subject guide. Past examination papers and markschemes, which detail how marks are awarded for each question, including for working shown, are available through the IBO store and are an excellent resource for worksheets, reviews and practice tests. Students should be required to show work in a logical and clear manner. Teachers should award some points to students for work shown even if the answer is not correct. This encourages students to persevere and diminishes the urge to give up. Finally, use of this document allows teachers and students to see how appropriate implementation of MYP mathematics philosophy paves the way for student success in either Math Studies SL or Math SL at the Diploma level.

Diploma Programme Skills Analysis

MATHEMATICAL STUDIES SL

This document identifies the skills and concepts necessary for success on the final DP assessments for Math Studies SL.

Group 5 Objectives —

Know and use mathematical concepts and principles:

- Read, interpret and solve a given problem using appropriate mathematical terminology
- Organize and present information and data in tabular, graphical and/or diagrammatic forms
- Know and use appropriate notation and terminology
- Formulate a mathematical argument and communicate it clearly
- Select and use appropriate mathematical strategies and techniques
- Demonstrate an understanding of both the significance and the reasonableness of results
- Recognize patterns and structures in a variety of situations, and make generalizations
- Recognize and demonstrate an understanding of the practical applications of mathematics
- Use appropriate technological devices as mathematical tools
- Demonstrate an understanding of and the appropriate use of mathematical modeling

Math Studies SL Syllabus Content:

- Introduction to the graphic display calculator
- Number and algebra
- Sets, logic, and probability
- Functions
- Geometry and trigonometry
- Statistics
- Introductory differential calculus

Diploma Program: Math Studies Standard Level Final Assessment			
External Assessment : Timed Exams	**Paper I: (40%)** 15 compulsory short-response questions based on the whole syllabus, designed to test students' breadth of knowledge across the syllabus. Candidates will be required to perform a small number of steps to solve each question and questions may be presented in the form of words, symbols, diagrams, tables or combinations of these. Candidates are required to use a GDC satisfying the minimum requirements. **1.5 hours**	**Skills** Refer to Math Studies SL Subject Guide pp. 12 – 26 for course content Students should be prepared to: • Justify answers with solutions presented in a logical manner (e.g. work vertically) • Clearly label diagrams, including graphs • Answer all aspects of a question even if one portion cannot be completed • Complete tasks under timed constraints	**Concepts** Refer to Math Studies SL Subject Guide pp. 12 – 26 for course content
	Paper II (40%) 5 compulsory extended response questions based on the whole syllabus, designed to test the candidate's depth of knowledge across the syllabus. Questions will require extended responses involving sustained reasoning and may be in the form of words, symbols, diagrams, tables or combinations of these. Questions generally begin with easier tasks at the start of the question and proceed to more challenging tasks, with an emphasis on problem solving. Candidates are required to use a GDC satisfying the minimum requirements. **1.5 hours**	**Skills** Refer to Math Studies SL Subject Guide pp. 12 – 26 for course content Students should be prepared to: • Justify answers with solutions presented in a logical manner (e.g. work vertically) • Clearly label diagrams, including graphs • Answer all aspects of a question even if one portion cannot be completed • Complete tasks under timed constraints	Refer to Math Studies SL Subject Guide pp. 12 – 26 for course content
Internal Assessment	**Project (20%)** A piece of written work based on personal research involving the collection, analysis, and evaluation of data. Students can choose from a wide variety of project types, but should utilize the mathematics learned in the course. The final mark will reflect the candidate using the following criteria: introduction, information/ measurement, mathematical processes, interpretation of results, validity, structure and communication, and commitment. The project is internally assessed by the teacher and externally moderated by IB.	**Skills** • Students should refer to the Math Studies SL Subject Guide pp. 12 – 26 to choose a topic Suggestions and guidance for implementing the project are available in the Teacher Support Material for the Internal Assessment. (Available on the OCC)	Refer to Math Studies SL Subject Guide pp. 12 – 26

9–12 Skills Map

MATHEMATICAL STUDIES SL

This document maps the skills and concepts necessary for success in the Diploma Programme over grades 9-12

MATH STUDIES STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
NUMBER			
Number systems			
Classification of solutions to equations as Natural, Integer, Rational and/or Real.	Solutions and graphs of equations over restricted domains.	Continual reference throughout the course where appropriate.	Use of Venn diagrams to represent the relationship between number systems.
Estimation and error			
Reasonableness of answers Use of various currencies in appropriate problems in order to gain a realistic idea of their value.	Reasonableness of answers Use of various currencies in appropriate problems in order to gain a realistic idea of their value.	Reasonableness of answers Use of various currencies in appropriate problems in order to gain a realistic idea of their value.	Formal evaluation of reasonableness using percentage error.
Standard Form (Scientific Notation)			
Use of standard form when solving problems writing answers.	Use of standard form when solving problems writing answers.	Use of standard form when solving problems writing answers.	Use of standard form when solving problems writing answers.
Units of measurement			
Use of metric units Conversion within the metric system (including area and volume) when solving problems Use of metric units where appropriate (e.g. as a scale for axes when graphing).	Use of metric units Conversion within the metric system (including area and volume) when solving problems.	Use of metric units. Conversion within the metric system (including area and volume) when solving problems.	Use of metric units. Conversion within the metric system (including area and volume) when solving problems.
ALGEBRA			
Sequences and series			
Connection of linear functions which represent arithmetic sequences.	Arithmetic and geometric sequences and series, links to linear and exponential functions such as simple interest, currency conversion, and compound interest.	Arithmetic and geometric sequences and series. Sum of finite series, apply to value of investments.	Continual reference throughout the course where appropriate.

MATH STUDIES STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Exponents			
	Laws of exponents. Exponential growth and decay. Applications.	Continual reference throughout the course where appropriate (e.g sequences and series).	Continual reference throughout the course where appropriate (e.g. financial math).
FUNCTIONS			
Representations			
	Function notation. Use of a variety of function notations (e.g. mapping, *"f(x) = ", "y = ",* etc.)	Use of a variety of function notations (e.g. mapping, *"f(x) = ", "y = ",* etc.).	Mapping diagrams and notation. Function notation
Linear			
Domain and range. Gradient. Write and graph linear equations. Applications. Parallel, perpendicular and skew.	Domain and range Write and graph linear functions using a variety of forms $(y = ax + c, y\text{-}y_1=a(x\text{-}x_1), \ldots)$ Coordinate plane Solutions of systems of linear equations algebraically and graphically.	Domain and range. Solutions of systems of linear equations using the GDC.	Domain and range. Review of writing linear equations.
Quadratic			
	Domain and range. Solutions of quadratic equations by factoring (use of the GDC is also encouraged).	Domain and range. Solutions of quadratic equations by factoring and using the GDC.	Review of maximum/minimum value.
Exponential			
	Domain and range. Graphs of exponential functions. Equations of asymptotes.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.
Trigonometric			
		Domain and range. Graphs of sine and cosine curves (in degrees only). Applications	Continual reference throughout the course where appropriate.

MATH STUDIES STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Other			
		Graphs of rational functions of the form $f(x) = \frac{1}{x+c}$ using a GDC. Awareness of asymptotic behavior. (Domain and range). Use of a GDC to graph and solve combinations of simple, unfamiliar functions (e.g. $5x=3^x$).	Continual reference throughout the course where appropriate.
GEOMETRY & TRIGONOMETRY			
Coordinate geometry			
Coordinate plane. Distance formula. Midpoint formula.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.
Three-dimensional shapes			
Area and surface area. Volume. Terminology such as trapezium and cuboid.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.	Surface area and volume of cuboids, prisms, pyramids, cylinders, cones, spheres and hemispheres.
Solving triangles			
Right triangles, formulas for the area of a triangle. SOHCAHTOA. Pythagorean Theorem.	Continual reference throughout the course where appropriate.	Right-angled trigonometry.	Right triangles. Sine rule. Cosine rule. Area of a triangle.
STATISTICS			
Statistical representations			
	Frequency tables and graphs, stem and leaf diagrams, and box and whisker plots.	Frequency tables and graphs (including grouped and non-grouped data). Cumulative frequency tables and graphs Use of cumulative frequency graphs to estimate percentiles. Discrete and continuous data. Box and whisker plots.	Continual reference throughout the course where appropriate.

MATH STUDIES STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
		Statistical measures	
	Mean, median and mode. Standard deviation.	Measures of central tendency and dispersion.	Continual reference throughout the course where appropriate.
		Correlation	
	Scatter diagram. Line of best fit by eye.	Scatter diagram. Calculation of the correlation coefficient using formulas from the IB information booklet (available on the OCC). Calculation of the equation for the regression line and its use for making appropriate predictions (within a reasonable domain).	Continual reference throughout the course where appropriate.
		χ^2 test for independence	
		Use the X^2 test of independence to determine if there is a relationship between two variables.	Continual reference throughout the course where appropriate.
		SETS, LOGIC & PROBABILITY	
		Set theory	
			Intersection, subsets, union, complement.
		Terminology	
	Use and understanding of terminology such as, sample space, outcome, event, etc.		Converse, inverse, contrapositive, conjunction, tautology, etc.
		Logical reasoning	
Deductive reasoning.			Use of truth tables to determine logical equivalence.
		Probability of events	
	Use and understanding of: Definition of probability, laws of probability (conjunction, disjunction, complement).		Laws of probability. Conditional probabilities. Independent and mutually exclusive events.

MATH STUDIES STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Probability diagrams			
	Tree diagrams and charts.	Continual reference throughout the course where appropriate.	Venn diagrams, tree diagrams, charts.
CALCULUS			
Differential			
			First and second derivatives of functions of the form $f(x) = ax^n + bx^{n-1} + \ldots, n \in Z$ Equations of tangent lines. Behavior of functions (increasing, decreasing and stationary). Application to maximum/ minimum points and optimization problems.
FINANCIAL MATH			
Currency conversion			
Awareness of various currencies in applications of topics (e.g. problems that deal with prices in euros as opposed to U.S. dollars).	Use of currency conversions as an application of linear functions.	Continual reference throughout the course where appropriate.	Solutions of problems involving currency conversion.
Interest			
Solutions of problems (e.g. linear equations) involving simple interest.	Compound interest formula.	Continual reference throughout the course where appropriate.	Use and application of simple and compound interest formulas.
TOPICS REVIEW			
	Previously learned topics should be incorporated throughout the course where appropriate.	Previously learned topics should be incorporated throughout the course where appropriate.	Review of all Math Studies SL Topics Use of past IB Math Studies SL exams is highly recommended.
INTERNAL ASSESSMENT *(i.e. the project)*			
Assessment tasks evaluated with the MYP criteria.	Assessment tasks evaluated with the MYP criteria.	Completion of the internal assessment.	

This is a sample of a progression that could be followed, with the assumption that Geometry is a 9th grade course and Algebra II is offered in grade 10. It should also be recognized that, while teachers are free to organize the content in grades 11 and 12, offering statistics in grade 11 allows students to use these skills in biology and psychology.

Diploma Programme Skills Analysis

MATHEMATICS STANDARD LEVEL

This document identifies the skills and concepts necessary for success on the final DP assessments for Math SL.

Group 5 Objectives

Know and use mathematical concepts and principles:

- Read, interpret and solve a given problem using appropriate mathematical terminology
- Organize and present information and date in tabular, graphical and/or diagrammatic forms
- Know and use appropriate notation and terminology
- Formulate a mathematical argument and communicate it clearly
- Select and use appropriate mathematical strategies and techniques
- Demonstrate an understanding of both the significance and the reasonableness of results
- Recognize patterns and structures in a variety of situation, and make generalizations
- Recognize and demonstrate an understanding of the practical applications of mathematics
- Use appropriate technological devices as mathematical tools
- Demonstrate an understanding of and the appropriate use of mathematical modeling

Math SL Syllabus Content:

- Algebra
- Functions and equations
- Circular functions and trigonometry
- Matrices
- Vectors
- Statistics and probability
- Calculus

Diploma Program: Math Standard Level Final Assessment			
External Assessment : Timed Exams	**Paper I: (40%)** **Part A:** Compulsory short-response questions based on the whole syllabus designed to test candidate's breadth of knowledge across the syllabus. Candidates will be required to perform a small number of steps to solve each question. Questions may be presented in the form of words, symbols, diagrams, tables or combinations of these. **Part B:** A small number of compulsory extended-response questions based on the whole syllabus, designed to test the candidate's depth of knowledge across the syllabus. Questions will require extended responses involving sustained reasoning and may be in the form of words, symbols, diagrams, tables or combinations of these. Emphasis will be placed on problem solving. *Candidates are not permitted to use a calculator*	**Skills** Refer to Math SL Subject Guide pp. 12 – 27 for course content Students should be prepared to: • Justify answers with solutions presented in a logical manner (e.g. work vertically) • Clearly label diagrams and graphs • Persevere in answering all aspects of a question even if one portion cannot be completed • Complete tasks under timed constraints, without a GDC	**Concepts** Refer to Math SL Subject Guide pp. 12 – 27 for course content
	Paper II (40%) **Part A:** Compulsory short-response questions based on the whole syllabus designed to test candidate's breadth of knowledge across the syllabus. Candidates will be required to perform a small number of steps to solve each question. Questions may be presented in the form of words, symbols, diagrams, tables or combinations of these. **Part B:** A small number of compulsory extended-response questions based on the whole syllabus, designed to test the candidate's depth of knowledge across the syllabus. Questions will require extended responses involving sustained reasoning and may be in the form of symbols, diagrams, tables or combinations of these. Emphasis will be placed on problem solving. *Candidates **are** required to use a GDC satisfying the minimum requirements* **1.5 hours**	**Skills** Refer to Math SL Subject Guide pp. 12 – 27 for course content Students should be prepared to: • Justify answers with solutions presented in a logical manner (e.g. work vertically) • Clearly label diagrams and graphs • Persevere in answering all aspects of a question even if one portion cannot be completed • Practice completing tasks under timed constraints, with and without a GDC	**Concepts** Refer to Math SL Subject Guide pp. 12 – 27 for course content

Diploma Program: Math Standard Level Final Assessment			
Internal Assessment	**Portfolio (20%)** A collection of two pieces of work assigned by the teacher and completed by the student during the course. The pieces of work must be based on different areas of the syllabus and represent the two types of tasks: • Mathematical investigation • Mathematical modeling The portfolio is internally assessed by the teacher and externally moderated by IB.	**Skills** Refer to Math SL Subject Guide pp. 12 – 27 to choose topics appropriate for each task. Suggested portfolio tasks are available in the Teacher Support Material for the Internal Assessment. However, these tasks cannot be used for final assessment after the November 2008 session. New tasks for 2009 and 2010 are now available on the OCC.	**Concepts** Refer to Math SL Subject Guide pp. 12 – 27

9–12 Skills Map

MATHEMATICS SL

This document maps the skills and concepts required for success in the Diploma Programme over grades 9-12.

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
NUMBER			
Number systems			
Classification of solutions to equations as Natural, Integer, Rational and/or Real.	Solutions of equations over restricted domains.	Relationships between number systems represented with Venn Diagrams.	Continual reference throughout the course where appropriate.
Estimation and error			
Reasonableness of results. Use of various currencies in appropriate problems in order to gain a realistic idea of their value.	Reasonableness of results. Use of various currencies in appropriate problems in order to gain a realistic idea of their value.	Reasonableness of results.	Reasonableness of results.
Standard Form (Scientific Notation)			
Use of standard form when solving and writing answers to problems.	Use of standard form when solving and writing answers to problems.	Use of standard form when solving and writing answers to problems.	Use of standard form when solving and writing answers to problems.
Units of measurement			
Use of metric units where appropriate (e.g. as a scale for axes when graphing). Use of metric units and conversion within the metric system (including area and volume) when solving problems.	Use of metric units where appropriate (e.g. as a scale for axes when graphing). Use of metric units and conversion within the metric system (including area and volume) when solving problems.	Use of metric units where appropriate (e.g. as a scale for axes when graphing).	Use of metric units where appropriate (e.g. as a scale for axes when graphing).

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
FUNCTIONS			
Representations			
	Function notation. Use of a variety of function notations (e.g. mapping, "$f(x) =$ ", "$y =$ ", etc.).	Mapping diagrams and notation. Function notation. Use of a variety of function notations (e.g. mapping, "$f(x) =$ ", "$y =$ ", etc.).	Continual reference throughout the course where appropriate.
Linear			
Domain and range. Gradient. Linear equations. Graphs. Applications.	Domain and range. Various forms of Linear equations. Coordinate plane. Solutions of systems of linear equations algebraically and graphically.	Solutions of systems of linear equations using the GDC.	Review writing linear equations.
Quadratic			
	Domain and range. Graphs of quadratic functions. Quadratic functions in the form $y=a(x+h)^2+k$ Solutions of quadratic equations by factoring and the quadratic formula (use of the GDC is also encouraged).	Domain and range. Graphs of quadratic functions. Use of the discriminant. Solutions of quadratic equations by factoring, the quadratic formula and using the GDC.	Continual reference throughout the course where appropriate.
Exponential and Logarithmic			
	Domain and range. Graphs of exponential functions. Relationship between exponential and logarithmic functions. Equations of asymptotes.	Graph exponential and logarithmic equations. Equations of asymptotes.	Continual reference throughout the course where appropriate.
Circular			
		Domain and range. Graphs of sine, cosine and tangent curves (in degrees and radians). Applications.	Continual reference throughout the course where appropriate.
Rational/reciprocal			
		Domain and range. Graphs of rational functions with and without a GDC. Equations of asymptotes. Use of a GDC to graph unfamiliar functions.	Continual reference throughout the course where appropriate.

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Transformations			
Rigid transformations (horizontal shift).	Transformations of quadratic functions Effects of parameters a, h and k on the graph of $f(x) = a(x - h)^2 + k$.	Transformations as applied to functions.	Continual reference throughout the course where appropriate.
Composite			
	Find composite functions in the form $f(g(x))$ and $(f \circ g)x$.	Find composite functions in the form $f(g(x))$ and $(f \circ g)x$.	Continual reference throughout the course where appropriate.
Inverse			
	Find and graph the inverse of quadratic and linear functions.	Find and graph the inverse of functions.	Continual reference throughout the course where appropriate.
GEOMETRY			
Coordinate geometry			
Coordinate plane. Distance formula. Midpoint formula. Parallel and perpendicular lines.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.
Shapes			
Area, surface area and volume . Terminology such as trapezium and cuboid.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.	Continual reference throughout the course where appropriate.
TRIGONOMETRY			
Arcs and angles			
	3-figure bearing and compass directions.	Radian measure. Arc length. Area of sector.	
Solving triangles			
Right triangles, formulas for the area of a triangle. SOHCAHTOA. Pythagoras' theorem.	Continual reference throughout the course where appropriate.	Right-angled trigonometry. Sine rule (including the ambiguous case). Cosine rule. Area of a triangle.	Continual reference throughout the course where appropriate.

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Identities			
		Tangent (include application to gradient), Pythagorean and double-angle identity.	Continual reference throughout the course where appropriate.
Equations			
Solutions of equations for angles in the first quadrant.		Solutions over a finite interval. Use of identities to solve equations.	Continual reference throughout the course where appropriate.
MATRICES			
Matrix operations			
		Algebraic operations with matrices (with and without a GDC). Algebraic operations with vectors written as a column matrix.	Continual reference throughout the course where appropriate.
Determinants			
		Determinants of 2x2 and 3x3 matrices should be calculated with and without a GDC. Inverses of matrices: 2x2 without a GDC, 3x3 and higher with a GDC.	Continual reference throughout the course where appropriate.
Systems of equations			
	Solutions of systems of equations graphically and algebraically.	Solutions of systems of equations using inverse matrices.	Continual reference throughout the course where appropriate.
VECTORS			
Vector operations			
		Addition, subtraction, multiplication by a scalar, scalar product of two and three-dimensional vectors.	Continual reference throughout the course where appropriate.
Applications			
Parallel, perpendicular and skew lines.		Angle between two vectors. Applications to motion of objects in two and three dimensions (including non-parallel lines which do not intersect) Representation of a line using vector notation.	Continual reference throughout the course where appropriate.

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
STATISTICS & PROBABILITY			
Terminology			
		Discrete, continuous, random sample, population.	Continual reference throughout the course where appropriate.
Statistical representations			
	Frequency tables and graphs, stem and leaf diagrams and box and whisker plots.	Continual reference throughout the course where appropriate.	Frequency tables and graphs (including grouped and non-grouped data). Cumulative frequency tables and graphs. Use of cumulative frequency graphs to estimate percentiles. Discrete and continuous data. Box and whisker plots.
Statistical measures			
	Mean, median and mode. Standard deviation.	Continual reference throughout the course where appropriate.	Measures of central tendency and dispersion.
Statistical distributions			
	Introduction of the normal distribution curve and that approximately 68% of the data lies within one standard deviation of the mean.	Continual reference throughout the course where appropriate.	Normal distribution and applications. Binomial distribution and applications. Expected value.
Probability of events			
	Definition of probability. Laws of probability (conjunction, disjunction, complement).	Laws of probability. Conditional probabilities. Independent and mutually exclusive events.	Continual reference throughout the course where appropriate.
Probability diagrams			
	Tree diagrams and charts.	Venn diagrams, tree diagrams, charts.	Continual reference throughout the course where appropriate.

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
CALCULUS			
Differential			
			Informal ideas of limits and convergence. Definition of the derivative. Familiarity with various forms of notation. Derivatives of exponential, logarithmic and trigonometric functions. The definition of derivative, Power rule, Product rule, Quotient rule and Chain rule. Equations of tangent lines. Behavior of a function (increasing, decreasing and stationary). Application to maximum/minimum points, curve sketching, kinematics.
Integral			
			Definite and indefinite. Applications to the area between curves and volumes of a solid of revolution.
INTERNAL ASSESSMENT (i.e. the portfolio)			
Assessment tasks evaluated with the MYP criteria B are particularly relevant to portfolio tasks.	Assessment tasks evaluated with the MYP criteria B are particularly relevant to portfolio tasks.	Students complete one or more portfolio task.* *Although only two portfolio tasks are required for the diploma, it is suggested that the students also complete practice tasks. This will allow students the opportunity to become familiar with the criteria (found in the subject guide).	Students complete one or more portfolio task.* *Although only two portfolio tasks are required for the diploma, it is suggested that the students also complete practice tasks. This will allow students the opportunity to become familiar with the criteria (found in the subject guide).

MATH STANDARD LEVEL TOPICS			
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
ALGEBRA			
Sequences and series			
Connection of linear functions with arithmetic sequences such as simple interest.	Arithmetic and geometric sequences and series, links to linear and exponential functions such as simple interest, currency conversion, and compound interest.	Arithmetic and geometric sequences and series. Sum of finite series, apply to value of investments. Sum of infinite geometric series. Sigma notation.	Continual reference throughout the course where appropriate.
Exponents and logarithms			
	Laws of exponents. Laws of logarithms. Exponential growth and decay. Applications.	Continual reference throughout the course where appropriate (e.g sequences and series).	Continual reference throughout the course where appropriate.
Binomial theorem			
	Expansion of polynomials of degree 2 and 3. Introduction to Pascal's triangle.	Expansion of binomials using the binomial theorem, Pascal's triangle or a GDC.	Continual reference throughout the course where appropriate.

This is a sample of a progression that could be followed, with the assumption that Geometry is a 9th grade course and Algebra II is offered in grade 10. It should also be recognized that, while teachers are free to organize the content in grades 11 and 12, offering statistics in grade 11 allows students to use these skills in biology and psychology.

MYP Assessment Map

MATHEMATICS STANDARD LEVEL
MATH STUDIES STANDARD LEVEL

This document makes connections between the MYP assessment criteria and the requirements of both Math Studies SL and Math SL and includes MYP assessment and scaffolding suggestions.

The purpose of this document is to demonstrate how criterion-related assessment in the MYP helps students transition to the DP final internal and external assessments. Much like the skills document demonstrates, the tables that follow show how assessment practices in MYP mathematics courses help lay the groundwork for success in future DP mathematics courses. By utilizing the criteria as described in the Mathematics guide, MYP teachers are helping prepare students for the assessment tasks that follow in future Diploma math courses.

The four criteria in MYP Mathematics should be applied consistently throughout the program. Modifications may be made in Years 1 to 3 as long as the original "flavor" of the criteria is preserved. With this in mind, mathematics teachers within a program should modify the criteria so that students are being led to eventual success with the MYP exit criteria as described in the subject guide. The following tables demonstrate how elements of each of the MYP criteria lead to readiness for each of the three assessments in the DP Math Studies Standard Level course.

MYP ASSESSMENT MAP: MATHEMATICS SL AND MATH STUDIES SL

External Assessment

MATH STUDIES SL
DIPLOMA PROGRAMME EXTERNAL ASSESSMENT
Papers 1 and 2 of the External Assessment have two parts.

External Asessessment for Math Studies SL is composed of two parts.

Paper I is comprised of 15 compulsory short-response questions based on the **whole syllabus,** designed to test students' **breadth of knowledge** across the syllabus. Candidates will be required to perform **a small number of steps to solve each question** and questions may be presented in a **variety of forms** including words, symbols, diagrams, tables or combinations of these.

Paper II is comprised of five extended response questions from the entire syllabus. Individual questions may require **knowledge of more than one topic** and oblige students to use **sustained reasoning**. Once again, questions may be represented in a **variety of forms with a focus on problem solving**. Students must **support answers by showing their work** and they may be awarded partial credit even if answers are incorrect as long as work is **logical, clear and correct notation is used.**
Students are required to use a GDC satisfying the minimum requirements in both Paper I and II.

MATHEMATICS SL
DIPLOMA PROGRAMME EXTERNAL ASSESSMENT
Papers 1 and 2 of the External Assessment for Mathematics SL are both comprised of two parts.

Section A is comprised of compulsory short response questions from the entire DP Math syllabus. A **small number of steps** will be required to answer each question and questions may be presented in a variety of forms. Questions require **showing appropriate work in order to solve problems, some of which are familiar and some of which are new**. Students are awarded partial credit even if answers are incorrect as long as work is **logical, clear and correct notation is used**. Questions and answers may be represented in a variety of forms, including words, symbols, tables, diagrams or any combination of these.

Section B is comprised of a small number of compulsory extended response questions from the entire syllabus. Individual questions may **require knowledge of more than one topic** and oblige students to use **sustained reasoning**. Once again, questions may be represented in a **variety of forms with a focus on problem solving**.

Students are not permitted to use any type of calculator in either part of Paper 1. A GDC is required for Paper 2.

CRITERION A: Knowledge & Understanding	CRITERION B: Investigating Patterns	CRITERION C: Communication in Mathematics	CRITERION D: Reflection in Mathematics
Students are asked to **solve challenging problems** and **make deductions**. They are required to solve problems in a **variety of contexts,** including those that are unfamiliar to them. Tests graded with this criterion should not include multiple choice questions. This will better approximate the types of questions included in Papers 1 and 2 of the DP external assessment. Teachers should also give a variety of tests, some requiring a calculator.	Students are asked to **select and apply problem solving techniques, draw conclusions** appropriate with findings and **provide justifications or proofs**.	Students are required to use a **variety of forms of representation** in presenting mathematical work. Lines of reasoning need to be logical, complete yet concise. Students are also able to **communicate** their solutions and results **using appropriate mathematical symbols and language.**	Students are able to **discern whether or not their results make sense** and also **assess the accuracy** of their answers.

MYP ASSESSMENT MAP: MATHEMATICS SL AND MATH STUDIES SL

Internal Assessment

MATH STUDIES SL
DIPLOMA PROGRAMME INTERNAL ASSESSMENT
Project

The project is a written piece of work based on research performed by the student that includes **data collection, analysis** and **evaluation**. Students may choose a project that involves an application of mathematics, mathematical modeling, investigation or a statistical survey. The project is not simply assigned by the teacher but, rather, chosen by the student.

Students are expected to clearly **communicate the mathematical process(es)** used and meaningfully **discuss the results** obtained, including **the validity and limitations of their findings**.

The project is evaluated using **criterion-referenced assessment** similar to that in the MYP.

MATHEMATICS SL
DIPLOMA PROGRAMME INTERNAL ASSESSMENT
Student portfolio

The student portfolio must contain two pieces of work:

Type I is a mathematical investigation where students are expected to solve a problem by **choosing an appropriate strategy, generating data and looking for a pattern.** Students should then **make deductions** based on generalizations that they find. They are expected to **explain/ communicate** their solution using a variety of representations and appropriate notation and terminology.

Type II involves mathematical modeling where students **solve a real-world problem** by constructing models, comparing their appropriateness and communicating this problem solving process. They are expected to **explain/communicate** their solution using a variety of representations and appropriate notation and terminology.
Both tasks are internally assessed by teachers using criterion-referenced assessment similar to that in the MYP.

CRITERION A: Knowledge & Understanding	CRITERION B: Investigating Patterns	CRITERION C: Communication in Mathematics	CRITERION D: Reflection in Mathematics
Students are asked to **solve challenging problems** and **make deductions**. They are required to solve problems in **a variety of contexts**, including those that are **unfamiliar** to them.	Students **select and apply** mathematical **problem-solving techniques**. Criterion B focuses on **recognizing patterns**, describing them as **relationships or general rules**, and **drawing conclusions** consistent with findings. Students also need to **provide justifications or proofs** for the rules that they discover. Producing a **mathematical model/ equation** from a set of **data** is particularly relevant to this portion of the MYP and DP assessments.	Students are required to use a **variety of forms of representation** in presenting mathematical work. Lines of reasoning need to be **logical**, **complete** yet concise. Students are also able to **communicate** their solutions and results **using appropriate mathematical symbols and language**.	Students explain whether **the results make sense** in the context of the problem and provide a **detailed explanation** of the importance of his or her findings in connection to real life. Students must also **justify the degree of accuracy** of the results where appropriate. Improvements to the method are suggested as students **evaluate their procedure** and recognize **alternative methods**. Students are also asked to **explain the importance** of their findings **in connection to real life**.

MYP Assessment Map: Mathematics SL and Math Studies SL

Sample Assessment Tasks	For Students Who Experience Difficulty:
Criterion A: Knowledge and Understanding	
Grade 9	
• Tests • Written reports/projects: Have students design their own bicycle and analyze/describe the relationships between the lengths and angles of the various components of its frame. Have students design and/or analyze works of art or pieces of architecture using geometric vocabulary.	• Instead of having students design their own bicycle, they could analyze already existing ones and/or compare the frames of mountain bikes and road bikes. • Students could be given photos of buildings, pyramids, etc. and asked to describe the relationships between the sides/lines that they see.
Grade 10	
• Tests • Written reports, projects: Have students research and report on Bode's Law (sequences and series) and justify whether or not they think Pluto should still be considered a planet. Have students research and compare cell-phone plans and decide which is most appropriate for them (systems of equations).	• Provide students with the development of the sequence of Bode's Law and direct their attention to the different sequences involved, asking questions at each stage (Is this an arithmetic or geometric sequence? Find an expression for the general term.) • Provide students with different cell-phone plans and ask them to graph each. Have them indicate where the plans are equal in cost and when one is more economical than the other.
Criterion B: Investigating Patterns	
Grade 9	
Students must recognize a pattern and describe it using a formula, for example: • calculating the value of π using a piece of string, a ruler and a pencil. • discovering the relationship between the sum of the interior angles of a regular polygon and the number of sides.	• Students could be given a graphic organizer (table) to fill in with the appropriate headings ("diameter", "approx. circumference", "C/d"). • Students could be given a graphic organizer (table) to fill in with the appropriate headings or they could be lead to the formula.

MYP Assessment Map: Mathematics SL and Math Studies SL

Sample Assessment Tasks	For Students Who Experience Difficulty:
Grade 10	
Students must recognize a pattern and describe it using a formula, for example: • Have students develop the formula for the sum of an arithmetic sequence $Sn = \frac{n(a_1 + a_n)}{2}$ from sets of sequences. • Have students fit a mathematical model to real data (exponential, quadratic, linear) by hand and/or using technology and making predictions. Data could be from hurricanes, science experiments, sports, etc..	• Provide students with the sequence in two columns side by side, with one column in the reverse order. Have them find the pattern from there. Extend more support to those still requiring it. • Provide students with appropriately scaled graph paper and ask them to plot the data. Have them choose which model fits best and find the equation using the y-intercept and any other point.

1	21
5	17
9	13
13	9
17	5
21	1

Criterion C: Communication in Mathematics

Grades 9 & 10	
Any tasks where students are required to explain their method and/or results are appropriate for assessment with this criterion.	Students could be asked to communicate orally at first and then move on to symbolic representation. Students should be encouraged to present their work as reports, stories, posters, etc. Students should use different forms of mathematical representation (formula, diagrams, tables, charts, graphs and models etc and be able to move between different forms of representation.

Criterion D: Reflection in Mathematics

Grades 9 & 10	
Any tasks where students have findings are appropriate for assessment with this criterion. Written reports/projects and those tasks that can be assessed with Criterion B are especially well-suited to assessment with Criterion D.	Outline exactly what is expected of the student, providing leading questions in the instructions, such as: "How accurate are your results? Explain." "What would you do differently next time? Explain." "Do your results make sense? How do you know? Explain." "How could you have used technology in solving the problem?"

Course Outlines
Example MYP Unit Planner

GEOMETRY Grade 9

This sample course outline, along with the unit plan, connects the analysis of skills and concepts with classroom practice in the MYP.

Course Description Geometry

The main objectives of this course are:

Students will be able to find the perimeter, area and volume of various two and three-dimensional shapes.

Students will be able to use axioms, theorems and proofs to show that figures and/or their elements are congruent or similar.

- Students will be able to use basic trigonometric ratios to solve problems.
- Students will be able to solve problems in the coordinate plane.

Instructional Strategies:

Students will learn mathematics through a variety of methods, including:

- Lecture;
- Discovery;
- Guided Practice;
- Experimentation;
- Cooperative learning;

Students will be given opportunities to discover concepts on their own, describe patterns and relate topics to one another. A spiraling instructional technique will be used to ensure that concepts learned are not forgotten (e.g. revisit the Pythagorean Theorem in the development of the distance formula). Teachers will model appropriate use of vocabulary, showing adequate working steps and attempting a variety of methods of solving a problem. Students will be given opportunities to see the development of a proof. They will start by simply filling in missing statements or reasons and eventually work their way to creating their own.

Vocabulary is a large part of Geometry, so using visual representations is essential if students are to remember this new language.

MYP COURSE OUTLINE GEOMETRY / GRADE 9

Unit 1: CONSTRUCTIONS AND DEFINITIONS *(2 weeks)*

Areas of Interaction	Significant Concept(s)
Human Ingenuity	Figures in geometry can be constructed with basic tools.

Unit Questions

Is Knowledge Power?

Content	Skills	Assessment	Materials/Resources
Students will be able to perform basic geometric constructions. They will also be able to use and find examples of the vocabulary of geometry.	Constructing perpendicular bisectors, angle bisectors and parallel lines; defining basic geometric terms.	"Geometry for Dummies" assignment Constructions and Definitions test	"Geometry for Dummies" books as examples **Interdisciplinary Connections** Language A and B: students prepare their own "Geometry for Dummies" book complete with constructions and definitions in 2 languages.

Unit 2: ANGLES, LINES AND TRANSVERSALS *(5 weeks)*

Areas of Interaction	Significant Concept(s)
Human Ingenuity	Intersecting lines form angles that are related to each other.

Unit Questions

What makes good art?

Content	Skills	Assessment	Materials/Resources
Students will be able to define the relationships between angles formed by parallel lines and transversals.	Defining and using the properties of complementary, supplementary, corresponding, alternate interior/exterior and vertical angles; constructing proofs.	"Constructing Cubism" assignment Angles, Lines and Transversals test	Examples of cubist art and architecture **Interdisciplinary Connections** Art: the study of cubism

MYP COURSE OUTLINE GEOMETRY / GRADE 9

Unit 3: TRIANGLES *(5 weeks)*

Areas of Interaction	Significant Concept(s)
Health and Social Education	Triangles are made up of sides and angles that have specific relationships with each other depending on the type of triangle.

Unit Questions

What speaks louder, actions or words?

Content	Skills	Assessment	Materials/Resources
Students will be able to classify triangles and prove whether or not they are congruent or similar. They will also be able to use the Pythagorean theorem to solve problems involving right triangles.	Finding the measures of sides and angles of triangles; proving triangles and their corresponding parts are similar or congruent; Using the Pythagorean theorem to find the lengths of sides of right triangles.	"The People vs. _____" assignment/debate Triangles test	Video on people's view of Earth being flat, round, etc. "The Thin Red Line" video **Interdisciplinary Connections** History: views of the Earth's shape over time, the judicial system Language A/B: persuasive writing/oral presentations/ Dramatic Arts: scriptwriting, oral presentations Science: views of the Earth over time (flat, round, center of the universe, etc.)

Unit 4: POLYGONS *(2 weeks)*

Areas of Interaction	Significant Concept(s)
Health and Social Education	Classification helps us understand the world.

Unit Questions

Is it important to be part of a group?

Content	Skills	Assessment	Materials/Resources
Students will be able to classify and find the properties of regular polygons.	Classifying polygons; finding the measures of interior angles; using their properties to solve problems.	"Systems of Classification" assignment Polygons test	Biology and Chemistry textbooks, models of animals/cars/objects that share similarities and differences **Interdisciplinary Connections** Science: Classification in Biology, properties of elements/metals/non-metals, etc. History: the caste/class system

MYP COURSE OUTLINE GEOMETRY / GRADE 9

Unit 5: CIRCLES *(5 weeks)*

Areas of Interaction	Significant Concept(s)	Content	Skills	Assessment	Materials/Resources
Human Ingenuity	Lines that intersect or touch circles form angles and measures that are related to one another.	Students will be able to solve problems involving relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.	Proving relationships between inscribed angles, inscribed and circumscribed polygons, chords, tangents, radii, etc. of circles; using these and the properties of circles to solve problems	"Design Your Own Crop Circle" assignment Circles Test	Photos of crop circles; Discovery Channel's video on the explanation of crop circles

Unit Questions

Is perfection humanly impossible?

Interdisciplinary Connections

Art: after studying cubism, students experiment with designs involving circles and Spiro-graph

Unit 6: PERIMETER, AREA, SURFACE AREA AND VOLUME *(7 weeks)*

Areas of Interaction	Significant Concept(s)	Content	Skills	Assessment	Materials/Resources
Human Ingenuity	The interplay between perimeter, area and volume can influence structure and form.	Students will be able to solve problems involving perimeter, area, surface area, lateral area and volume of two-dimensional and three-dimensional shapes.	Computing perimeter, areas and volumes of shapes such as triangles, rectangles, rhombi, parallelograms, trapezoids, prisms, pyramids, cylinders, cones and spheres	"Building a New Stadium" assignment 2-d shapes test 3-d shapes Test	Blueprints of existing stadium Architect/urban planner from city Statistics of attendance at games

Unit Questions

"What influences how and why we build?"

Interdisciplinary Connections

Art: construction of models

Language A: report writing

MYP COURSE OUTLINE GEOMETRY / GRADE 9

Unit 7: COORDINATE AND TRANSFORMATIONAL GEOMETRY *(5 weeks)*

Areas of Interaction	Significant Concept(s)	Content	Skills	Assessment	Materials/Resources
Health and Social Education; Human Ingenuity	The coordinate plane allows one to study and represent a variety of real-life applications.	Students will be able to solve problems involving points in the coordinate plane. They will also be able to define the effects of rotations, reflections and translations.	Using distance and midpoint formulas to solve problems and prove theorems using also equations of lines and circles; finding the effects of reflections, rotations and translations on figures in the coordinate plane.	"You be the GPS" OR "3-d Art" assignment (Students have a choice) Coordinate and Transformational Geometry Test	Maps and atlases (originals with copies to be made later) Portable GPS Computers; CAD; computer teacher **Interdisciplinary Connections** Geography: longitude and latitude Technology: computer art; CAD

Unit Questions

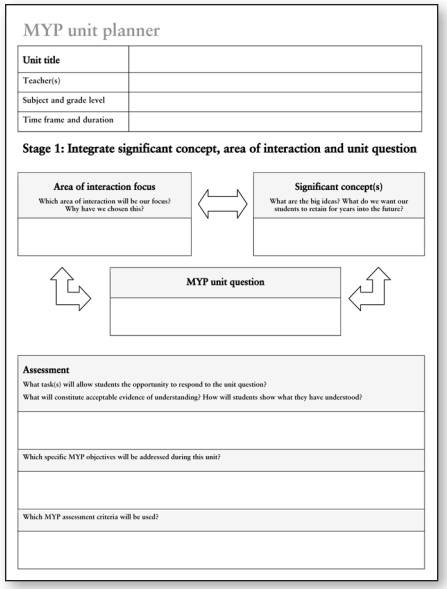
"How does technology affect our lives?"

Unit 8: Trigonometry *(5 weeks)*

Areas of Interaction	Significant Concept(s)	Content	Skills	Assessment	Materials/Resources
Health and Social Education	The angles we see every day are the result of specific calculations.	Students will be able solve problems with right triangles through the use of trigonometric ratios.	Solving right triangles; finding the trig. ratios of special triangles; proving and using basic trigonometric identities $\sin^2 A + \cos^2 A = 1$ and $\tan A = \sin A / \cos A$.	"Access for All" assignment Trigonometry test	City code regarding wheelchair accessibility Examples of ramps in and around the school/other schools Wheelchair-bound student **Interdisciplinary Connections** Design technology: woodworking; designing and building ramps

Unit Questions

"What does 'accessibility' mean?"


MYP unit planner

Unit title	
Teacher(s)	
Subject and grade level	
Time frame and duration	

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus
Which area of interaction will be our focus? Why have we chosen this?

Significant concept(s)
What are the big ideas? What do we want our students to retain for years into the future?

MYP unit question

Assessment
What task(s) will allow students the opportunity to respond to the unit question?
What will constitute acceptable evidence of understanding? How will students show what they have understood?

Which specific MYP objectives will be addressed during this unit?

Which MYP assessment criteria will be used?

Example MYP Unit Planner

GEOMETRY Grade 9

The MYP Unit Planner is a resource for teachers planning MYP instruction. The following MYP unit of work was developed to reflect the skills and concepts outlined previously in this document. Along with the preceding course outline, this unit of work provides an example of the kind of instruction that can prepare students for success in the Diploma Programme

Unit Title	Constructions, Lines and Transversals
Subject and Grade Level	Geometry (Year 3)
Time frame and Duration	Sept. 4 – Sept. 15

Stage 1: Integrate significant concept, area of interaction and unit question, and ensure it can be assessed

AREA OF INTERACTION FOCUS
Which AoI will be your focus?
Why have you chosen this?

Human Ingenuity

This Area of Interaction will help students consider the way mathematics informs art and aesthetics

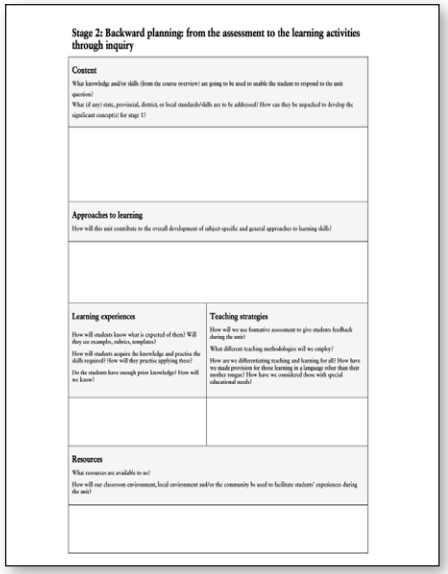
SIGNIFICANT CONCEPT(S)
What are the big ideas? What do I want my students to retain for years into the future?

Understanding humans' role in the Art is not simply about creating "just anything". Artists design their works using very specific shapes, lines and textures. Mathematics can be used to produce and analyze art.

MYP UNIT QUESTION

What makes "good art"?

Stage 1: Assessment	
Unit Planner Prompt	*Teacher Response*
What task(s) will allow students the opportunity to respond to the unit question? **What will constitute acceptable evidence of understanding?** **How will students show what they have understood?**	The summative assessment task asks students to produce or reproduce a piece of art (picture, sculpture, etc.) using various geometric constructions (perpendicular bisector, angle bisector, transversal, alternate interior angles, etc.). Students will be asked to not only state the measures of angles, but also the reason(s) why they were able to calculate them. An analysis of the piece of art will also be done to compare the student's work with that of a cubist artist and explanations of the effects of their constructions and angles on the work will be given. Acceptable understanding will be shown through analysis of the piece of art created with particular attention paid to the elements required (as selected by the entire class).
Which specific MYP objectives will be addressed during this unit?	**A. Knowledge and Understanding** • know and demonstrate understanding of the concepts from the five branches of mathematics • use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts **C. Communication** • use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations • move between different forms of representation
Which MYP assessment criteria will be used?	A, C, and D


Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills)

Learning experiences

How will students know what is expected of them? Will they see examples, rubrics, templates?

How will students acquire the knowledge and practice the skills required? How will they practice applying them?

Do the students have enough prior knowledge? How will we know?

Teaching strategies

How will we use formative assessment to give students feedback during the unit?

What different teaching methodologies will we employ?

How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Unit Planner Prompt	*Teacher Response*
CONTENT **What knowledge and/or skills (from my course overview) are going to be used to enable the student to respond to the unit question?** **What (if any) state, provincial, district, or local standards/skills are to be addressed?**	Students will use their skills in constructing lines, bisectors, angle bisectors, perpendicular bisectors and parallel lines in order to produce a piece of artwork that fits their definition of "good". They will also use the skills developed in analyzing relationships between angles (complementary, alternate interior, vertically opposite, corresponding, etc.) to describe elements of their artwork that they feel make it "good" (e.g. symmetry, reflections, etc.). **California Content Standards:** **7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles. **16.0** Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.
APPROACHES TO LEARNING **How will this unit contribute to the overall development of subject-specific and general AtL skills?**	This unit will expand the students' **knowledge-acquisition skills** by not only building on previously learned concepts, but also in getting them to apply them to a new context. The final assessment will promote **communication skills** and **thinking skills** through a detailed written analysis of their artwork and comparison to cubism. This brief study of cubism will also promote **information literacy skills** as students research this art form and consistent use of self-assessment throughout the unit will enhance students' **reflection skills.** The use of a rigorous schedule for the completion of various stages of the artwork will also help students develop appropriate **time management skills**.

Stage 2: Backward planning: from the assessment to the learning activities through inquiry	
Learning Experiences **How will students know what is expected of them? Will they see examples, rubrics, templates, etc.?** **How will students acquire the knowledge and practise the skills required? How will they practise applying these?** **Do the students have enough prior knowledge?**	**Teaching Strategies** **How will we use formative assessment to give students feedback during the unit?** **What different teaching methodologies will we employ?** **How are we differentiating teaching and learning for all? Have we considered those learning in a language other than their mother tongue? Have we considered those with special educational needs?**
Teacher Response	*Teacher Response*
The analysis that is asked of students on a daily basis will mirror the summative assessment task's requirements. Students will constantly analyze examples of artwork (cubist paintings, photography, sculpture, models, etc.) that exemplify the vocabulary and concepts. They will be asked to evaluate each piece of art based on new information and prove any relationships among angles. A "mini work of art" will be constructed to give students practice with the constructions and putting them all together. Students will then be given a chance to find their own work of art and analyze it. These will be the precursors to the summative assessment where they will make their own piece of art and analyze it with the concepts learned. Other forms of assessment, such as quizzes, will also be used to ensure that students are able to relate these "real-world" skills to more mathematical-type problems.	Students designed their own "visual dictionaries" for the vocabulary, complete with a mathematical definition, their own definition and an example from art. This helped with their communication, knowledge-acquisition and organizational skills. Students worked in collaborative groups initially as they analyzed the pieces of art and peer edited later analyses. The relationship established between geometry and cubism and the subsequent creation of their own work of art pushed students to think more abstractly and try to visualize how concepts learned would appear when used in concert to create a picture.
(continued on next page)	

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Teaching Strategies *(continued)*

Lesson 1: Introduction & Perpendicular Bisectors

- Students will analyze a work of cubist art seen in a previous Visual Arts class and review previously learned concepts in geometry as well as the use of a protractor.
- Students will also be asked to construct a visual dictionary of all of the vocabulary seen in the unit (a work in progress, Visual Dictionary assessment task not included in this document).
- Students will learn to construct the perpendicular bisector of any segment.

Lesson 2: Angle Bisectors and Parallel Lines

- Students will analyze a new cubist piece of art to find the previous vocabulary as well as angle bisectors and parallel lines. This will go into the visual dictionary and students will then learn how to make these constructions. A "mini piece of art" will be constructed that will require at least 5 of each of the constructions (clearly labeled on the back or another copy).

Lessons 3 and 4: Parallel Lines and Transversals

- Students will learn the relationships between angles formed by parallel lines and transversals, with particular attention to corresponding angles, alternate interior, alternate exterior, and supplementary angles. Having learned the vocabulary, they will identify these angles in a cubist work of art and measure their actual values to prove the relationship. Students will practice making constructions of parallel lines and transversals and identifying congruent and supplementary angles.

Lesson 5: Putting it all together

- Students will analyze "mathematical questions" involving parallel lines and transversals and find the value of angles. Students will then begin creating and analyzing their own work of art using the concepts learned in this unit.

These lessons are clearly documented in the detailed lesson plans that follow (not included in this document).

Unit Planner Prompt	*Teacher Response*
RESOURCES **What resources are available to us?** **How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?**	Use of local museums and their collections for examples of cubist artwork and photography, Year 3 Art teacher, possibly a visit to a local museum/art gallery/photo gallery.

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice.*

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

Figure 12
MYP unit planner

Stage 3: Ongoing Reflections and Evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions in the unit planning section of ***MYP: from principles into practice***.

Unit Planner Prompt	*Teacher Response*
STUDENTS AND TEACHERS **What did we find compelling? Was our disciplinary knowledge/skills challenged in any way?** **What inquiries arose during the learning? What, if any, extension activities arose?** **How did we reflect—both on the unit and on our own learning?** **Were there any attributes of the learner profile that were encouraged through this unit? Were there any opportunities for action?**	Students seemed to enjoy tying their work in Math to the study of cubism. We started off by looking at specific cubist paintings that they had already seen in Art class using a Math perspective. Students were very good at pointing out elements learned in prior math courses, making this a very effective method of review. Terminology came to life now that it was in front of them in a non-mathematical context. This set the stage for what seemed to be "art class" rather than "math class", which made teaching much easier. Students quickly asked whether or not artists chose to use the constructions/ concepts or if they were merely a coincidence. Students also discussed how Math made art more interesting and the impact of mathematical structures on works of art. They indicated that knowing the math helped in the design of their own art as they now had tools with which to create (especially those who identified themselves as "non-artistic").
POSSIBLE CONNECTIONS **How successful was the collaboration with other teachers within my subject group and from other subject groups?** **What interdisciplinary understandings were or could be forged through collaboration with other subjects?**	This unit connected well with the Year 3 Art course and their study of cubism. It reinforced what students had learned previously about cubism and related to what they had studied about geometry in earlier mathematics courses. The artwork produced in for this Math unit was also assessed with the Visual Arts criteria. Possible connections could also be made with Computer Technology classes by asking students to create their art using software. *(continued on next page)*
ASSESSMENT **Were students able to demonstrate their learning?** **Did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? Did I make sure students were invited to achieve at all levels of the criteria descriptors?** **Are we prepared for the next stage?**	
DATA COLLECTION **How did I decide on the data to collect? Was it useful?**	

Stage 3: Ongoing Reflections and Evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions in the unit planning section of ***MYP: from principles into practice***.

Unit Planner Prompt	*Teacher Response*
STUDENTS AND TEACHERS **What did we find compelling? Was our disciplinary knowledge/skills challenged in any way?** **What inquiries arose during the learning? What, if any, extension activities arose?** **How did we reflect—both on the unit and on our own learning?** **Were there any attributes of the learner profile that were encouraged through this unit? Were there any opportunities for action?**	*(continued from previous page)* Students successfully demonstrated their learning with the summative and formative assessment tasks. By constantly analyzing pieces of art as new vocabulary was introduced, students were well-equipped to tackle making and analyzing their own. The "mini work of art" was a good strategy for integrating the various constructions together while also giving plenty of practice. The stated objectives were easily met with the assessment tasks. Data was collected on how well students used the vocabulary from the unit and to what extent were all concepts utilized. While students had very few problems with the most basic of definitions, they still seemed to confuse "corresponding" and "alternate interior angles" or simply did not see them in the samples that were analyzed. By examining the extent to which students utilized all of the concepts, I can make changes to the amount of emphasis and instruction given to those that were less well understood and/or used. Also, this is the first time that students have been exposed to such an analytical and creative instructional technique. Examining the data on student achievement (in general) will help teachers decide on the usefulness of such pedagogy and where improvements can be made. (For example, students still need more work on constructing perpendicular bisectors and angle bisectors. They can identify them, but still need more practice actually constructing them.)
POSSIBLE CONNECTIONS **How successful was the collaboration with other teachers within my subject group and from other subject groups?** **What interdisciplinary understandings were or could be forged through collaboration with other subjects?**	
ASSESSMENT **Were students able to demonstrate their learning?** **Did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? Did I make sure students were invited to achieve at all levels of the criteria descriptors?** **Are we prepared for the next stage?**	
DATA COLLECTION **How did I decide on the data to collect? Was it useful?**	

Course Outlines
Example MYP Unit Planner

ALGEBRA II Grade 10

This sample course outline, along with the unit plan, connects the analysis of skills and concepts with classroom practice in the MYP.

Course Description

The main objectives of this course are:

- Students will be able to manipulate algebraic expressions and solve different types of equations
- They will be able to solve problems involving equations and systems of equations
- Students will be able to graph a variety of functions
- Students will be able to calculate the probability of events

Instructional Strategies:

Students will learn mathematics through a variety of methods, including:

- Lecture;
- Discovery;
- Guided Practice;
- Experimentation;
- Cooperative learning;Students will be given opportunities to discover concepts on their own, describe patterns and relate topics to one another. A spiraling instructional technique will be used to ensure that concepts learned are not forgotten (e.g. revisit factoring in rational expressions, relate sequences and series to exponential functions, etc.). Teachers will model appropriate use of vocabulary, showing adequate working steps and attempting a variety of methods of solving a problem. Students will be given opportunities to solve real-world applications of algebra and relate new algebraic concepts to previously learned ones in both Algebra and Geometry.

MYP COURSE OUTLINE ALGEBRA II

Unit 1: POLYNOMIALS *(4 weeks)*

Areas of Interaction	Significant Concept(s)
Community and Service	While algebra is a tool for describing and representing real-life phenomena, it is more easily used when expressions are simplified.

Unit Questions

"Am I a resource?"

Content	Skills	Assessment	Materials / Resources
Students will be able to perform operations on polynomials	Factoring; Adding, subtracting, multiplying, dividing polynomials; Expanding binomials using Pascal's triangle	"The Visual Algebra Dictionary" Polynomials test	Dictionaries **Interdisciplinary Connections** Language A and B: students prepare their own mathematical dictionary in 2 languages

Unit 2: LINEAR FUNCTIONS AND SYSTEMS OF EQUATIONS *(3 weeks)*

Areas of Interaction	Significant Concept(s)
Health and Social Education	Linear functions are useful tools to describe and compare relationships between two variables.

Unit Questions

"What influences our choices?"

Content	Skills	Assessment	Materials / Resources
Students will be able to find the equations of lines and solve systems of linear equations and inequalities.	Finding the equation of a line; Solving a system of linear equations with more than two variables; Solving a system of linear inequalities by graphing; Solving optimization problems	"Cell Phone Plan" assignment Linear Functions and Systems of Equations test	Newspapers **Interdisciplinary Connections** Humanities: Economics and optimization problems

Unit 3: QUADRATIC FUNCTIONS *(4 weeks)*

Areas of Interaction	Significant Concept(s)
Human Ingenuity	A relationship exists between pictorial, symbolic and descriptive representations.

Unit Questions

"What makes good art?"

Content	Skills	Assessment	Materials / Resources
Students will be able to graph quadratic functions, find their zeros and describe the transformations applied to $y = x^2$	Completing the square; Solving quadratic equations; Graphing; Recognizing transformations	"Parabolic Art" assignment Quadratic Functions test	Artwork (paintings, pictures that include parabolas e.g. St. Louis arch) **Interdisciplinary Connections** Art: the study of arcs and curves

MYP COURSE OUTLINE ALGEBRA II

Unit 4: RATIONAL EXPRESSIONS *(4 weeks)*

Areas of Interaction	Significant Concept(s)
Human Ingenuity	Rational expressions are simply an extension of the study of fractions.

Unit Questions

"Which is the path of least resistance?"

Content	Skills	Assessment	Materials / Resources
Students will be able to simplify rational expressions	Adding, subtracting, multiplying and dividing rational expressions; Finding the restrictions on the variable; Solving rational equations	"Circuits" assignment Rational Expressions test	Physics circuit boards, ammeters, voltmeters, ohmmeters **Interdisciplinary Connections** Physics: the study of electrical circuits

Unit 5: EXPONENTIAL AND LOGARITHMIC FUNCTIONS *(6 weeks)*

Areas of Interaction	Significant Concept(s)
Environment	Many real-life phenomena can be modeled using exponential and logarithmic functions.

Unit Questions

"Who has the power to predict the future?"

Content	Skills	Assessment	Materials / Resources
Students will be able to graph exponential functions and use them to describe everyday phenomena; Students will be able to use logarithms to solve problems and to describe everyday phenomena	Finding the equation of an exponential function; Solving exponential and logarithmic equations; Simplifying logarithmic expressions; Solving problems involving interest, depreciation, half-life, doubling, applications of logarithms, etc.	"Hurricanes 'R' Us" assignment Exponents and Logarithms Test	Atlases, NASA hurricane video "27 Storms", almanacs **Interdisciplinary Connections** Science: the study of climatology, earthquakes and sound

Unit 6: SEQUENCES AND SERIES *(4 weeks)*

Areas of Interaction	Significant Concept(s)
Environment	Patterns occur naturally and mathematics can be used to analyze and describe them.

Unit Questions

"Which is more natural, organization or chaos?"

Content	Skills	Assessment	Materials / Resources
Students will be able to describe sequences, find the sum of series and use them to solve problems	Finding recursive and explicit formulas for arithmetic and geometric sequences; Finding the sum of arithmetic and geometric series including infinite geometric series; Solving problems involving sequences and series	"Is Pluto a Planet" assignment Sequences and Series test	Newspaper articles (re. Pluto's demotion to dwarf planet), solar system video **Interdisciplinary Connections** Science: the study of astronomy

MYP COURSE OUTLINE ALGEBRA II

Unit 7: CONIC SECTIONS *(5 weeks)*

Areas of Interaction	Significant Concept(s)
Environment	A shape is defined by its properties (and vice versa).

Unit Questions

"Which is more natural, organization or chaos?"

Content	Skills	Assessment	Instructional Strategies
Students will be able to describe circles, ellipses, hyperbolas and parabolas using the locus of points definition, the cutting of a cone and an equation	Finding the equation of a circle, ellipse, parabola and hyperbola given specific information; Finding the coordinates of vertices, foci and the center; Solving problems involving conic sections	"The Shape of Your World" assignment Conic sections test	Examples of conic sections in "real life" e.g. toilet bowls, Roman arches, pictures of Monument Valley **Interdisciplinary Connections** Design Technology: woodworking

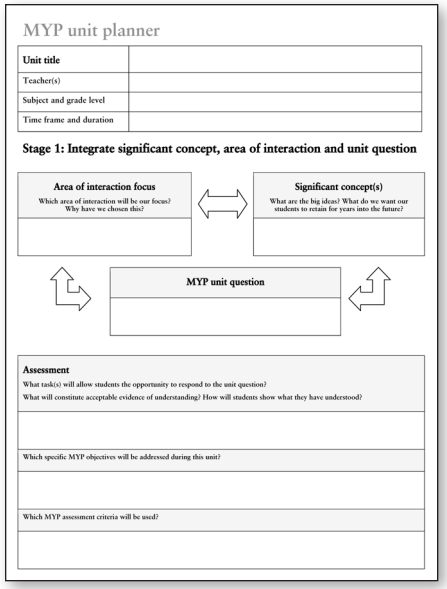
Unit 8: PERMUTATIONS AND COMBINATIONS *(5 weeks)*

Areas of Interaction	Significant Concept(s)
Health and Social Education	Whether or not order matters influences the chances that events will occur.

Unit Questions

"Is order important?"

Content	Skills	Assessment	Materials / Resources
Students will be able to use permutations and combinations to find the probability of events involving choices	Finding the number of ways of choosing outcomes (order may or may not matter); Using the Fundamental Counting Principle; Calculating probabilities of events involving choice, including compound events; Expanding binomials using combinatorics	"You Be the Jury" assignment Permutations and Combinations test	"The Thin Red Line" video **Interdisciplinary Connections** Humanities: the judicial system


MYP unit planner

Unit title	
Teacher(s)	
Subject and grade level	
Time frame and duration	

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus
Which area of interaction will be our focus? Why have we chosen this?

Significant concept(s)
What are the big ideas? What do we want our students to retain for years into the future?

MYP unit question

Assessment
What task(s) will allow students the opportunity to respond to the unit question?
What will constitute acceptable evidence of understanding? How will students show what they have understood?

Which specific MYP objectives will be addressed during this unit?

Which MYP assessment criteria will be used?

Example MYP Unit Planner

ALGEBRA II Grade 10

The MYP Unit Planner is a resource for teachers planning MYP instruction. The following MYP unit of work was developed to reflect the skills and concepts outlined previously in this document. Along with the preceding course outline, this unit of work provides an example of the kind of instruction that can prepare students for success in the Diploma Programme.

Unit Title	Exponential Functions
Subject and Grade Level	Algebra II (Year 4)
Time frame and Duration	Sept. 18 – Sept. 30

Stage 1: Integrate significant concept, area of interaction and unit question, and ensure it can be assessed

AREA OF INTERACTION FOCUS
Which AoI will be your focus?
Why have you chosen this?

Environment
Students will investigate the use of mathematics and modeling to explore environmental phenomenon such as the prediction of natural disasters. This connects to students' work in Science on weather and climatology.

SIGNIFICANT CONCEPT(S)
What are the big ideas? What do I want my students to retain for years into the future?

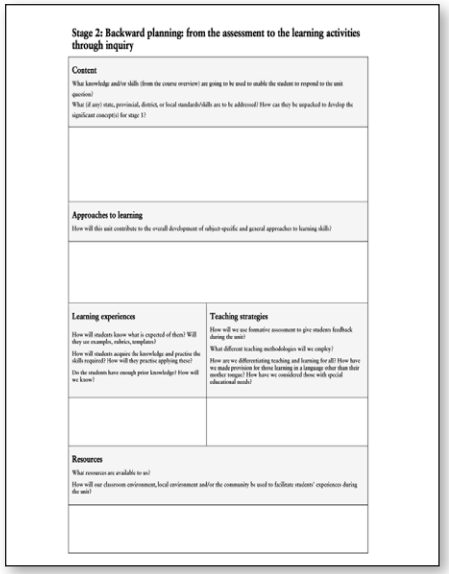
Mathematics provides tools to predict and model real life phenomena.

MYP UNIT QUESTION

Who has the power to predict the future?

Stage 1: Assessment	
Unit Planner Prompt	*Teacher Response*
What task(s) will allow students the opportunity to respond to the unit question? **What will constitute acceptable evidence of understanding?** **How will students show what they have understood?**	The summative assessment task asks students to take real hurricane data and predict where it will be three and six hours after the last given data point. Students are asked to model the data using exponential, linear and quadratic functions and then decide which model is best. Predictions are made with the chosen model and suggestions made as to whether or not evacuation of any areas is necessary. Students will need to be able to draw graphs, represent data with a linear, quadratic and exponential model and then choose which best suits their data. Acceptable evidence of understanding will include all graphs, equations and supporting work as well as predictions and recommendations based on their findings..
Which specific MYP objectives will be addressed during this unit?	**A KNOWLEDGE AND UNDERSTANDING** • know and demonstrate understanding of the concepts from the five branches of mathematics. • use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts. **B INVESTIGATING PATTERNS** • select and apply appropriate inquiry and mathematical problem-solving techniques. • recognize patterns. • describe patterns as relationships or general rules. • draw conclusions consistent with findings. • justify or prove mathematical relationships and general rules. **C COMMUNICATION IN MATHEMATICS** • use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations. • use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models). • move between different forms of representation. *(continued on next page)*

Stage 1: Assessment	
Unit Planner Prompt	*Teacher Response*
(continued from previous page) **Which specific MYP objectives will be addressed during this unit?**	*(continued from previous page)* **D REFLECTION IN MATHEMATICS** • explain whether their results make sense in the context of the problem. • explain the importance of their findings. • justify the degree of accuracy of their results where appropriate. • suggest improvements to the method when necessary.
Which MYP assessment criteria will be used?	B, C and D


Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills)

Learning experiences

How will students know what is expected of them? Will they see examples, rubrics, templates?

How will students acquire the knowledge and practice the skills required? How will they practice applying them?

Do the students have enough prior knowledge? How will we know?

Teaching strategies

How will we use formative assessment to give students feedback during the unit?

What different teaching methodologies will we employ?

How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Stage 2: Backward planning: from the assessment to the learning activities through inquiry	
Unit Planner Prompt	*Teacher Response*
CONTENT **What knowledge and/or skills (from my course overview) are going to be used to enable the student to respond to the unit question?** **What (if any) state, provincial, district, or local standards/skills are to be addressed?**	Students will need to be able to graph data, recognize the relationship as either linear or exponential and find an appropriate equation to accurately represent these data. They will need to be able to solve exponential equations and to substitute values for variables in order to make predictions. **California Content Standards:** 11.2 Students judge the validity of an argument according to whether the properties of real numbers, exponents, and logarithms have been applied correctly at each step. 12.0 Students know the laws of fractional exponents, understand exponential functions, and use these functions in problems involving exponential growth and decay. 15.0 Students determine whether a specific algebraic statement involving rational expressions, radical expressions, or logarithmic or exponential functions is sometimes true, always true, or never true.
APPROACHES TO LEARNING **How will this unit contribute to the overall development of subject-specific and general AtL skills?**	This unit will expand the students' knowledge-acquisition skills by not only building on previously learned concepts, but also in getting them to apply them to a new context. The final assessment's presentation will promote communication skills, information and communication technology skills, and thinking skills as students not only model their hurricane data but also research the region affected by the hurricane, describe the method used to model its path and evaluate areas of weakness and strength. Evident in this is also reflection skills as students assess their own work. Collaborative skills will be promoted throughout the unit as students work in groups to discover concepts in this unit with a heavy emphasis on problem solving.

Stage 2: Backward planning: from the assessment to the learning activities through inquiry	
Unit Planner Prompt	*Unit Planner Prompt*
Learning Experiences **How will students know what is expected of them? Will they see examples, rubrics, templates, etc.?** **How will students acquire the knowledge and practise the skills required? How will they practise applying these?** **Do the students have enough prior knowledge?**	**Teaching Strategies** **How will we use formative assessment to give students feedback during the unit?** **What different teaching methodologies will we employ?** **How are we differentiating teaching and learning for all? Have we considered those learning in a language other than their mother tongue? Have we considered those with special educational needs?**
Teacher Response	*Teacher Response*
Students will be shown an example of a video, a PowerPoint presentation, a research-oriented paper and a creative piece of writing. This will demonstrate the creativity that can go into the presentation of findings as well as the depth of reflection, explanation and research. Students will be engaged initially by watching a NASA video entitled "27 Storms" where the entire hurricane season from 2005 is displayed from satellite images depicting each storm's path. Students will already have knowledge of quadratic and linear functions and will have used them to model real-life phenomena. They will have little knowledge of hurricanes, aside from what they have seen on television. An initial pre-test on modeling data and fitting an exponential curve to it will diagnose student prior knowledge (which should be limited). While teaching, the possible misconceptions will include them trying to calculate the "slope" despite the data following a curvilinear pattern. Also, they are likely to need practice solving a system of exponential equations with two unknowns. *(continued on next page)*	Students will be shown an example of a video, a PowerPoint presentation, a research-oriented paper and a creative piece of writing. This will demonstrate the creativity that can go into the presentation of findings as well as the depth of reflection, explanation and research.

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Learning Experiences / Teaching Strategies *(continued)*

Students will be presented with data from other natural phenomena (volcanoes, earthquake data, etc.) and asked to model them using the appropriate function. A mini-assignment using one of these data sets will serve as a formative assessment and model the mathematical work to follow in the summative assessment. Written feedback will be given to each student so that they may improve for the summative task.

Lesson 1: Introduction

- Students will watch the NASA video and be introduced to the Area of Interaction that is the focus of the unit. As they watch the video, they will be asked to identify the paths they see.
- Students will be asked to graph $y = 2^x$, $y = 3^x$ and $y = (1/2)^x$ by hand. These curves will be named as either exponential growth or decay and related to prior work on quadratics. (e.g. What makes a curve exponential as opposed to quadratic? What are some similarities and differences? What defines exponential growth and exponential decay?)

Lesson 2: Exponential Graphs

- Students will study in depth the graphs of exponential functions, paying particular attention to asymptotes, the parameters that coincide with exponential growth and decay and finding the equation of a graph given points on it. Students will be asked to fill in a graphic organizer as they discover the properties of exponential functions.

Lesson 3: Exponential Equations

- Students will learn how to solve exponential equations by guessing and checking and by re-writing using the same base. (They don't know anything about logarithms yet.) This will be compared to strategies used to solve other types of equations such as quadratic, square root, linear, etc.

Lesson 4: Applications

- Students will use exponential functions to model problems involving finances, volcanoes, populations and bacteria.
- They will set up an exponential equation and then solve for the desired value.

Lesson 5: More applications

- Students will use exponential functions to model real data by drawing a graph and finding the regression equation by hand and using a graphing calculator. Students will then make a prediction based on their model, simulating the summative assessment task. They will also solve problems based on their data that require them to solve exponential equations.

These lessons are clearly documented in the detailed lesson plans that follow (not included in this document).

Stage 2: Backward planning: from the assessment to the learning activities through inquiry	
Unit Planner Prompt	*Teacher Response*
RESOURCES **What resources are available to us?** **How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?**	NASA webpage, Year 4 Science teacher, possibly a visit by a local television station's meteorologist. Also, we have several students in school who were displaced due to hurricane Katrina. They will be brought in for a more "human" element and to reinforce the importance of prediction.

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice.*

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?
What inquiries arose during the learning? What, if any, extension activities arose?
How did we reflect—both on the unit and on our own learning?
Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?
What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?
How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?
Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

Figure 12
MYP unit planner

Stage 3: Ongoing Reflections and Evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions in the unit planning section of ***MYP: from principles into practice***.

Unit Planner Prompt	*Teacher Response*
STUDENTS AND TEACHERS **What did we find compelling? Was our disciplinary knowledge/skills challenged in any way?** **What inquiries arose during the learning? What, if any, extension activities arose?** **How did we reflect—both on the unit and on our own learning?** **Were there any attributes of the learner profile that were encouraged through this unit? Were there any opportunities for action?**	Students loved the NASA video as well as the focus on natural phenomena. They really seemed to be committed to learning when they realized that it would help them better understand something they thought was 'cool' yet didn't know a lot about. Students very quickly realized that finding exponential models were easy when the initial value (value at t = 0) is given. They asked what to do when it was not provided, something we were going to cover anyway!! Also, they wanted to know how to decide which points to use in the model since the choice of points defined the function and changed the outcome. A Q&A with an online resource helped answer that from a weather forecaster's perspective. (The computer updates predictions faster than humans can.) This unit connected well with the Year 4 Science Unit on Climate. It reinforced what students had learned previously about earthquakes and volcanoes and allowed them to see it from a more mathematical perspective. A possible connection next year would be either through Technology or Language A where students would be asked to present their work in a specific format. Students were able to demonstrate their learning and they seemed to enjoy using this new knowledge. All students were able to find an exponential model for their data, although some were not able to use technology to draw graphs. The formative tasks led very well to the summative *(continued on next page)*
POSSIBLE CONNECTIONS **How successful was the collaboration with other teachers within my subject group and from other subject groups?** **What interdisciplinary understandings were or could be forged through collaboration with other subjects?**	
ASSESSMENT **Were students able to demonstrate their learning?** **Did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? Did I make sure students were invited to achieve at all levels of the criteria descriptors?** **Are we prepared for the next stage?**	
DATA COLLECTION **How did I decide on the data to collect? Was it useful?**	

Stage 3: Ongoing Reflections and Evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions in the unit planning section of ***MYP: from principles into practice***.

Unit Planner Prompt	*Teacher Response*
STUDENTS AND TEACHERS **What did we find compelling? Was our disciplinary knowledge/skills challenged in any way?** **What inquiries arose during the learning? What, if any, extension activities arose?** **How did we reflect—both on the unit and on our own learning?** **Were there any attributes of the learner profile that were encouraged through this unit? Were there any opportunities for action?**	*(continued from previous page)* one and students performed much better on criterion D than in the past after having done some peer review. I am collecting data on student performance on criterion B and D in particular since these are the two they typically struggle with most. Having had several opportunities to perform similar assessment tasks with linear and quadratic functions, I am looking for progressively higher grades and more profound reflection. These data allow me to rework previous assessment tasks and instructional strategies so that students can start achieving at higher levels sooner. I am also sending these results to the DYP Math teachers so that they can see at what level students are achieving on tasks that are similar to what is expected of them in future courses.
POSSIBLE CONNECTIONS **How successful was the collaboration with other teachers within my subject group and from other subject groups?** **What interdisciplinary understandings were or could be forged through collaboration with other subjects?**	
ASSESSMENT **Were students able to demonstrate their learning?** **Did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? Did I make sure students were invited to achieve at all levels of the criteria descriptors?** **Are we prepared for the next stage?**	
DATA COLLECTION **How did I decide on the data to collect? Was it useful?**	